Docket No. 2000-021

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ON APPEAL TO THE BOARD OF APPEALS

In re: Application of:

Floyd J. Hildebrant,
Thelma G. Manning,
and
Ronald L. Simmons

Examiner: Aileen Falton Baker

Serial No.: 10/711,651

Group Art Unit: 1755

Filed: September 29, 2004

For: A SINGLE BASE IM PROPELLANT USING BUNENA AS ENERGETIC PLASTICIZER

APPELLANT'S BRIEF ON APPEAL

Board of Patents Appeals and Interferences,
United States Patent and Trademark Office,
PO Box 1450,
Alexandria, Virginia 22313-1450

Dear Sir:

This paper is submitted in compliance with 37 C.F.R. § 41.37, and is a Brief on behalf of the Appellant in the above-captioned appeal from the final rejection of claims 1 to 5. No claims have been allowed in the present application.

ORAL HEARING

No oral hearing on the issues in this appeal has been requested.

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37 C.F.R. § 41.37(c)(i) Real Party in Interest

The real party in interest in this Application is the United States of America. The present application is assigned of record to the United States of America, as represented by the Secretary of the Army.

37 C.F.R. § 41.37(c)(ii) Related Appeals and Interferences

None.

37 C.F.R. 41.37(c)(iii) Status of Claims

The claims are 1 to 5. All claims stand rejected and appealed.

37 C.F.R. § 41.37(c)(iv) Status of Amendments

There are no unentered amendments.

37 C.F.R. § 41.37(c)(v) Summary of The Claimed Invention

(a) Summary

A gun propellant formulation comprising: a nitrocellulose component comprising from about sixty-five percent (65.0%) to about ninety-five (95.0%) of the gun propellant by weight, having a nitrogen proportion of substantially twelve and six-tenths percent (12.6%) nitrogen; an energetic plasticizer component comprising from about 5.0 percent (5.0%) to about 35 percent (35.0%) of the gun propellant by weight, and comprising N-Butyl-2Nitratoethyl Nitramine (BuNena); a burning rate moderator and stabilizer component comprising from about one-half of one percent (0.5%) to about five percent (5.0%) of the gun propellant by weight, and comprising Sym-Diethyl Diphenyl Urea, N,N'-Diethyl Carbanilide (Ethyl Centralite, Centralite I); and a stabilizer component comprising about one-half of one percent (0.5%) to about five percent (5.0) of the gun propellant by weight, and comprising Acetyl triethyl citrate (ATEC). Additional components comprising less than 5% of the gun propellant may optionally include Graphite, carbon black, and candelilla wax.

(b) Background

Many gun propellant compositions are manufactured with, or contain, various compounds that may be environmentally hazardous or even toxic. This is particularly true of certain munitions.

For example, current formulation of a number of a number of widely used gun propellants contains toxic and hazardous materials including dinitrotoluene (DNT), dibutylphthalate (DBP), and diphenylamine (DPA). Significantly, diphenylamine (DPA) is classified as a highly toxic material, dibutylphthalate (DBP) is a suspected carcinogen and - according to a study prepared by the United States Department of Health and Human Services exposure to dinitrotoluene (DNT) is associated with an increased frequency of liver, bile duct and gall bladder cancers.

Removing these toxic and hazardous materials from the manufacture of gun propellants would therefore be a great improvement in the health and safety of workers preparing such munitions. Additionally, if certain solvents that are commonly used in the manufacturing process of gun propellants were eliminated, a number of environmental concerns would be eased. Accordingly, a new formulation that permits both the removal of

hazardous and toxic components and eliminates the need for certain hazardous solvents in the manufacturing process would represent great progress in the art.

At the same time, there are other undesirable characteristics of current gun propellant formulations - such as its susceptibility to an unintended detonation resulting from a kinetic energy penetrator - that, if eliminated or made more desirable, would also represent a significant improvement in the art.

Accordingly, the development of gun propellant compositions that are energetically favorable which minimally impact the environment and are sufficiently insensitive to unintended detonation(s) - remains a significant unrealized objective of gun propellant development and is therefore the subject of the present invention.

(c) The Invention

Our novel gun propellant, which is the subject of the present invention, is both a "green" propellant and an "insensitive" munitions (IM).

Advantageously, it is considered a green propellant in that it contains no known hazardous and toxic substances. Consequently our inventive gun propellant represents a major step forward in the art when considering production workers who prepare the gun propellant or those who contact the propellant after its preparation. Additionally, the "green" nature of the gun propellant benefits the environment as a whole - since propellant residue exists in the environment long after its use.

Of further advantage, is the insensitive munitions (IM) characteristic of our propellant. As can be appreciated by those skilled in the art, gun propellant such as this is oftentimes the subject of training or other "live-fire" exercises in which personnel actually use the gun propellant. Unfortunately, accidents occur in which live rounds containing gun propellant are mishandled or struck by objects having a high kinetic energy. It is extremely desirable in such occurrences that the live rounds which are struck do not detonate as such unintended detonation may result in a catastrophic loss of property or life.

Advantageously, our novel formulation of gun

propellant is relatively insensitive to such detonations, thereby rendering it advantageous over the art for such training operations in which unintended detonations are increasingly possible.

We have achieved the above-mentioned characteristic advantages of our gun propellant formulation through the use of a relatively unique plasticizer, N-Butyl-2-Nitratoethyl Nitramine (BuNena). BuNena itself exhibits a number of useful characteristics and its use in our gun propellant formulation similarly affects the training rounds.

In particular, BuNena is energetic, meaning that it contributes energetically to the overall gun propellant. In addition, it plasticizes (colloids) the nitrocellulose polymer(s) into a relatively homogeneous mass. Furthermore, BuNena acts as a processing aid during manufacture and imparts improved mechanical properties to the gun propellant such as elasticity and flexibility and lastly - but of great importance - it imparts the IM properties to the gun propellant.

Importantly, and in summary, BuNena can provide comparable performance at the same time providing a gun

propellant with reduced sensitivity.

As can be readily appreciated by those skilled in the art, these seemingly mutually exclusive - but desirable - properties sharply contrast the properties provided by other, known plasticizers widely used in the art. In particular, plasticizers that are energetic tend to make the resulting gun propellant more sensitive. Conversely, plasticizers, which are not energetic - while their use may result in an insensitive munition - produce gun propellants exhibiting undesirable or insufficient energies.

BuNena - unlike other plasticizers used in the art - imparts an increase in energy and reduced sensitivity. It is officially classified as a flammable liquid and not an explosive.

The preparation of our novel munitions propellant proceeded as follows.

EXAMPLE PREPARATION

A nominal quantity of test formulation was prepared in the following manner. A quantity of alcohol-wet nitrocellulose having a

Nitrogen content of twelve and six-tenths percent (12.6%) Nitrogen was worked in the presence of solvents to loosen the nitrocellulose fibers and stored to keep the water content uniform.

A variety of solvents, including Acetone, Ethyl Acetate and DiEthyl-Ether are all satisfactory solvents for this working and generally comprise 40%-60% by weight. Various factors such as flammability may contribute to the decision of which particular solvent is chosen.

It should be noted at this point that the nitrocellulose used need not be a single purity. In particular, a blend (cotton lint blend) of nitrocellulose may be used with satisfactory results. More particularly, a blend of nitrocellulose, for example a blend of 13.15% Nitrogen Nitrocellulose and 11.3% Nitrogen Nitrocellulose is satisfactory. Other blends would likely work as well so long as the overall Nitrogen is substantially 12.6%.

Returning now to our formulation, other materials were prepared as follows. A pre-dissolved plasticizer/stabilizer mixture was made with the following components: BuNena, and Acetyl Tri-Ethyl Citrate (ATEC) diethyl diphenyl urea which is otherwise known in the trade as Ethyl Centralite (EC).

The nitrocellulose was added to a sigma blade mixer. To this, the previously prepared plasticizer/stabilizer mixture was added and the combined materials were mixed together.

The resulting paste was extruded in a ram press, cut into granules, and allowed to dry and "flash off" substantial residual solvents by drying for approximately one (1) day at room temperature and approximately three (3) days at about 120 degrees Fahrenheit.

Of course, it will be understood by those skilled in the art that the foregoing is merely illustrative of the principles of this invention, and that various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention. In particular, different components - particularly those that impart further desirable mechanical characteristics to the finished gun propellant - may be added to the list of ingredients. In particular, graphite - a conductive powder - may be added in small quantities (i.e., between 0.1 and 5 %) to further improve the insensitivity of the munitions propellant to electrostatic discharge. In addition, components such as Potassium Sulfate may be added, to further reduce muzzle flash of a detonated round containing the munitions propellant. Such additions of components

imparting further well-known characteristics are envisioned. Accordingly, my invention is to be limited only by the scope of the claims attached hereto.

(d) Support for Each Claim

Claim 1 is the only independent claim. Support for this claim can be found in paragraphs 12 to 15 and paragraphs 29 to 33 of the Specification.

37 C.F.R. § 41.37(c)(vi) Grounds of Rejection to be Reviewed on Appeal

The claims are 1 to 5. All claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,602,361 to Hamilton and Baglini, in view of U.S. Patent 6,228,192 to Neidert, Scheffee, Bowman, and Martin, and U.S. Patent 6,607,618 to Manning and Prezelski. It is the Examiner's position that the Hamilton and Baglini reference discloses known gun-type propellants that comprise 76.6% of 13.25% nitrocellulose, 20% of a plasticizer such as nitroglycerin, 0.6% of ethyl centralite, and 0.4% graphite. The Examiner has also noted that acetyl triethyl citrate is shown with other gun propellants.

The Neidert, *et al.*, reference is cited as teaching the use of BuNena as an energetic plasticizer for nitrocellulose, and it is the Examiner's position that the reference teaches the equivalence of BuNena to nitroglycerin.

Finally, the Examiner cites the Manning and Prezelski reference as disclosing the use of a mixture of nitrocellulose with a 12.6% nitrogen content with nitrocellulose with a 13.35% nitrogen content. In addition, the reference is cited to show the use of additives such as graphite, potassium sulfate, and Candelilla wax in gun propellants.

It is the Examiner's view that it would have been obvious to modify the gun propellant of the Hamilton and Baglini reference, using acetyl triethyl citrate with ethyl centralite and graphite, but substitute BuNENA for nitroglycerin as the plasticizer, as taught by the Neidert *et al.,* reference, and, further, modify the nitrocellulose as taught by the Manning, *et al.,* reference.

37 C.F.R. § 41.37(c)(vii) Argument

United States Patent 5,602,361 to Hamilton and Baglini is entitled Hybrid Inflator. It is concerned with a hybrid inflator for an automotive inflatable safety system. The system of the reference provides a gun type propellant as a gas generator combined with a mixture of gases, including the necessary oxygen to complete combustion of the propellant gases, so that the hydrogen and carbon monoxide liberated by the gas generator can be further oxidized to harmless water and carbon dioxide. In doing so, the reference discloses the composition of a double base, smokeless propellant with the composition cited by the Examiner. This composition, HPC-96, is primarily nitrocellulose and nitroglycerin, with ethyl centralite, barium nitrate, potassium nitrate, and graphite. Acetyl triethyl citrate is

not employed in this composition. It is employed in a completely different propellant, M39 LOVA, but that propellant contains 76% RDX in a cellulose acetate butyrate binder. Only 4% of the composition is nitrocellulose. Acetyl triethyl citrate is not shown in a nitrocellulose-based propellant composition in this, or any other, reference.

United States Patent 6,228,192 to Neidert, Scheffee, Bowman, and Martin is entitled Double Base Propellant Containing 5-Aminotetrazole. This reference discloses a family of propellant compositions containing nitrocellulose plasticized with nitrate esters, a thermal stabilizer, carbon, and an energetic solid. There is no suggestion of a mixture of a nitrocellulose with a 12.6% nitrogen content with a nitrocellulose with a 13.25% nitrogen content, and the nitrocellulose content is below 40%. There is no ethyl centralite or acetyl triethyl citrate. Carbon black is present, but so is an energetic solid filler, 5-aminotetrazole and its derivitives, in a proportion of five to thirty-five percent.

United States Patent 6,607,618 to Manning, a common inventor with the present application, and Prezelski is entitled Propellant Compositions. The compositions shown therein comprise about 52% nitrocellulose which is a mixture of nitrocellulose having a 12.6% nitrogen content and a nitrocellulose having a 13.35% nitrogen content; 34 to 35% diethylene glycol dinitrate (DEGDN), a nitroester-based plasticizer; 3 to 4% di-normal propyl adipate (DNPA), a non-nitroester-based plasticizer; and 7% nitroguanidine (NQ).

Additives, such as Graphite, Potassium Sulfate, Ethyl Centralite and Candelilla wax, are also shown. There is no acetyl triethyl citrate.

The present invention is a nitrocellulose-based single-base propellant, containing neither the nitroglycerin of the Hamilton and Baglini reference, the 5-aminotetrazole of the Neidert, *et al.*, reference, or the nitroguanidine of the Manning and Prezelski reference. This is a significant difference in that while inert plasticizers reduce sensitivity, they also reduce performance. Energetic plasticizers, on the other hand, typically enhance performance, but with an accompanying increase in sensitivity. As noted in the present specification, at paragraph 26, BuNena – unlike other plasticizers used in the art – imparts an increase in energy and reduced sensitivity. It is an energetic and is not the "equivalent" of nitroglycerin. It is officially classified as a flammable liquid and not an explosive.

Neidert, *et al.,* employs a class of nitrate esters, and that class includes BuNena, but that reference discloses a double-base propellant with a substantial (5 to 35 weight%) energetic solid loading. Any loss in energetic performance caused by substituting a nitrate ester plasticizer for nitroglycerin would be compensated by the addition of an energetic solid. Nowhere, within the four corners of the document, is it suggested that BuNena is the equivalent of nitroglycerin.

Finally, nowhere in any of the references, is there a suggestion that acetyl triethyl citrate be used in a nitrocellulose-based propellant composition, and certainly not a nitrocellulose-based single base propellant.

Nor, it is submitted, is the design of an effective propellant a matter of a menu selection: such one from column A and two from column B. In addition to achieving a balance of energetics with appropriate performance and flame temperature, there are many additional considerations. The Neidert, *et al.*, reference sets out some measure of this difficulty:

"The prior art, therefore, has failed to disclose a family of gas generating compositions useful as propellants in aerospace applications that has a stable component formulation characterized by low sensitivity, a flame temperature less than 3050º F., combustion exhaust products with optimum system compatibility, optimum ballistic properties and increased working life, and that can be formulated cost effectively from available components."
(U.S. Patent 6,228,192, at Column 2, lines 17 to 24).

If these considerations were not enough, in recent years other concerns have impacted upon the materials and methods for the production of energetics. These considerations are detailed in the current specification in paragraphs 5 through 9, and include the environmental compatibility of the raw material

components, the solvents used in processing, and the reaction by-products of the ignition of the energetic.

In such an environment, the design of an effective energetic would require more that the mere mention of a particular compound in passing in a prior art reference.

37 C.F.R. § 41.37(c)(viii) Claims Appendix

What is claimed is:

1(appealed). A munitions propellant comprising:

an alcohol-wet nitrocellulose component comprising about 65.0% to about 95.0% of the gun propellant by weight, said nitrocellulose component having a Nitrogen proportion of substantially 12.6% Nitrogen;

an energetic plasticizer component comprising about 5% to about 35% of the gun propellant by weight, said energetic plasticizer component comprising N-Butyl-2-Nitratoethyl Nitramine (BuNena);

a burning rate moderator and stabilizer component comprising from about one-half of one percent (0.5%) to about five percent (5.0%) of the gun propellant by weight, wherein the burning rate

moderator and stabilizer component is one selected from the group consisting of: Sym-Diethyl Diphenyl Urea, N,N'-Diethyl Carbanilide (Ethyl Centralite, Centralite I); and N-Methyl N',N'-Diphenyl Urea (Akardite II); and

a stabilizer component comprising about one-half of one percent (0.5%) to about five percent (5.0) of the gun propellant by weight, and comprising Acetyl triethyl citrate (ATEC).

2(appealed). The munitions propellant of claim 1 wherein the nitrocellulose component comprising about 65.0% to about 95% of the gun propellant by weight is a combination of a first nitrocellulose composition having a Nitrogen proportion of about 13.4% Nitrogen and a second nitrocellulose composition having a Nitrogen proportion of about 11 .3% Nitrogen, such that the combination has an average Nitrogen proportion of about 12.6% Nitrogen.

3(appealed). The gun propellant of claim 1, further comprising additional components, wherein the additional components comprising less than about 5% of the munitions propellant by weight include a first additional component, comprising about 1.0% to 2.0% of the munitions propellant by weight, said first additional

component comprising graphite; a second additional component, comprising about 1.0% to 2.0% of the guns propellant by weight, said second additional component comprising Potassium Sulfate; and a third additional component comprising about 1.0% to 2.0% of the munitions propellant by weight, said third additional component comprising Candelilla Wax.

4(appealed). The gun propellant of claim 2, further comprising additional components, wherein the additional components comprising less than about 5% of the gun propellant by weight include a first additional component, comprising about 1.0% to 2.0% of the munitions propellant by weight, said first additional component comprising graphite; a second additional component, comprising about 1.0% to 2.0% of the gun propellant by weight, said second additional component comprising Potassium Sulfate; and a third additional component comprising about 1.0% to 2.0% of the gun propellant by weight, said third additional component comprising Candelilla Wax.

5(appealed). The gun propellant of claim 4, wherein the nitrocellulose component is prepared using organic solvents including Acetone, Ethyl Acetate and DiEthyl-Ether.

37 C.F.R. § 41.37(c)(ix) Evidence Appendix

None.

37 C.F.R. § 41.37(c)(x) Related Proceedings Appendix

None.

Conclusion

Appealed claims 1 to 5 are submitted to be patentable. Reversal of the Examiner is therefore respectfully requested.

Respectfully submitted,

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